

Using computer modelling to predict areas to search for chequered skipper butterflies *Carterocephalus palaemon* (Pallas, 1771) in Scotland

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The chequered skipper *Carterocephalus palaemon* (Pallas, 1771) is a native, UK Biodiversity Action Plan Priority butterfly species found in western Scotland.

The butterfly was well-known and reasonably widespread in the 19th and 20th centuries in the midlands of England, with scattered records as far as Devon, but gradually declined from the early 1900s. It remained common in the east midlands until the 1950s. It then underwent a rapid decline and became extinct in its last known English site in 1976.

In Scotland, the species was unknown until it was first found in the Lochaber area in 1939 (Thomson, 1980) and remained poorly recorded for the next 40 years. Surveys by the Scottish Wildlife Trust in the 1980s and Butterfly Conservation in the 1990s then established its general distribution. Records up to 2011 suggest that the Chequered Skipper is restricted to within a 30 mile radius of Fort William, from Loch Arkaig in the north to Loch Etive in the south, Ardrisaig in the west to Spean Bridge in the east.

The butterfly requires areas of lush purple moor-grass (the larval food plant) and this is often found growing near bog myrtle. The adult butterflies can be found in or near this habitat particularly where there are suitable nectar plants e.g. bugle, marsh thistle, bluebell and orchids, growing nearby in sunny, sheltered locations.

Adults are usually found in sunny glades or along the edges of damp woodland. In warm and sunny weather they are extremely active and fly with a swift, darting, almost moth-like manner that is difficult to follow as they 'skip' just above the vegetation.

The males guard their territories from favourite perches - often scrub, bracken or bog myrtle - flying out to inspect passing insects with the aim of

pursuing rival males and intercepting females. Females tend to be encountered in more open areas searching for suitable breeding sites. The butterfly could be mistaken for a small day-flying moth and is thus easily overlooked.

After mating, eggs are laid singly on purple moor grass in early June. The caterpillar spins the edges of the grass together to form a protective tube. Once it has eaten the leaf-blade down to the mid-rib, the caterpillar moves to a new leaf and starts again. In September the green caterpillar abandons its shelter and makes two semi-circular notches, one above the other, on opposite sides of the leaf-blade. It feeds on the leaf above this double-notch. The notches are thought to restrict the flow of nutrients from the leaf to the roots, creating a more nutritious meal.

The caterpillars hibernate from late October or early November to April within the spun leaves of their food plant. By spring they have changed to a fawn colour to match their surroundings and do not feed before pupating on the ground. The adult butterfly emerges around six weeks later.

Maintenance of flower-rich areas in sunny, sheltered locations is crucial for adults. Light deer browsing is important to prevent encroaching scrub shading out nectar plants. Light grazing, especially in autumn/winter, maintains flower-rich areas, but higher levels of grazing, particularly by sheep in the spring, can be damaging.

Chequered Skipper populations have declined where deer and livestock have been excluded from sites managed under woodland regeneration schemes due to loss of open space and nectar plants.

The adults and caterpillars have different requirements; at many sites their habitats occur as a mosaic. Females can move 1-2 km between nectar sources and breeding sites through open woodland and moorland. The precise habitat requirements are

not fully understood, although the following general principles apply:

The caterpillars spend most of their lives high-up on the food-plant, so light grazing can diminish food supplies, and also lead directly to mortality of caterpillars. However, breeding habitat usually occupies wetter areas which grazing animals generally avoid, unless stocking levels are high.

Its long-term survival, as with many other species, is more likely if sites are linked, enabling an exchange of adults between neighbouring colonies. The fragmentation of suitable habitat is damaging, making the surviving populations more isolated.

Many colonies now only survive under power-lines; chequered skipper and other butterflies benefit from the 7-10 year cyclical clearance of scrub beneath the wayleaves. Similar management can be deployed at under-grazed and un-grazed sites to retain or create open space along paths and rides and maintain glades. At larger sites this clearance should be staggered to produce open spaces at different stages of succession. Ideally rides and paths should run east-west to create a warm south-facing edge.

Butterfly Conservation's Allt Mhuic reserve is an area of grassland, moorland and native woodland between two large conifer plantations on the north side of Loch Arkaig. Butterfly Conservation run the reserve in conjunction with Forestry Commission Scotland. The reserve is intended to be used to build up knowledge of what kinds of management suit the chequered skipper (and other species), and which do not. The management of the reserve is being carefully monitored. Highland cattle have been used to do some of the light grazing required to keep the habitat suitable for the skippers, with mixed results, depending on time of year and number of cattle. Summer grazing was undertaken for eight years, but winter grazing over the last four years has so far given better results.

Butterfly Conservation use the reserve as a demonstration site and give talks to interested parties to describe the butterfly's ecology and requirements and how best to manage similar habitats in the area. They also have one to one meetings with land owners and managers on their own land to explain how to help the butterfly by undertaking appropriate management. This in turn is beneficial to the farmers, as they are more likely to be able to access grants if they are managing for the butterfly.

This can be done where the butterfly is known to occur, but do we really know the current distribution of the chequered skipper?

In 2011, Dr Tom Brereton, Head of Monitoring at Butterfly Conservation and Stuart Ball, Chief Analyst in the Data Services Team with JNCC, looked at what is believed to be the chequered skipper's requirements in terms of habitat, vegetation, topography, aspect, climate, amount of cloud and rainfall. They used a computer model which produced a remarkably good fit to the existing records, plus many potential new locations in which to search (Ball, 2012).

Taking the known distribution up to 2011, they then added the top 100 predicted 1km squares for the butterfly which the modelling suggested were best to search for chequered skippers, where they hadn't previously been recorded.

Most of these are within or close to the current known distribution area. However, there are also squares in the far north, in north-west Sutherland; in the Cowal Peninsula; and also one on Mull. Interestingly there were a couple of unsubstantiated reported sightings from Mull in the past.

The computer model suggests that the butterfly may have been under-recorded by 20% at a 10km level, and possibly by an astounding 400% at a 1km level. The next stage was to get groups of volunteers out to look at possible new sites to confirm the theory. In 2012, surveys were undertaken between mid-May and the end of June. Surveyors were asked to spend a minimum of an hour in the 1km square they were checking, or until they found a chequered skipper. They recorded the weather, time spent, other species seen, and other relevant information.

Despite the poor weather the survey raised a good deal of interest with over 50 volunteers signing up to take part. There were 49 survey visits to squares, (although this includes repeat visits by different surveyors to some squares) made to 36 different squares.

No chequered skippers were found in 21 of these squares, but the butterflies were found in 15 new predicted squares, and also in 15 additional new squares which had not been predicted in the top 100 (Prescott, 2012).

It was looked for, but not found on Mull, but encouragingly, there were some significant records elsewhere. The most southerly known Scottish sighting, in Glen Nant; a record from immediately to the east of Kinlochleven, which is around 7km to the east of the closest previous record; and a good population was found in seven 1km squares at the western end of Loch Arkaig, on the north-western edge of the butterfly's range (see Fig. 1).

Following the success in 2012, the survey was repeated in 2013. Visits were made to only 16 squares. Due to the very cold and late spring, the survey period was restricted to just over two weeks, and finished ten days earlier than 2012, which was probably the main reason for fewer squares being visited.

Efforts in 2013 concentrated mainly on two areas: Glen Etive and Loch Leven, and many of these records were made by a small number of recorders over a few days of good weather. Excluding repeat visits to the same squares Chequered Skipper was found in just six 'new' squares, although it had previously been seen in two of these in 2012. Of the remaining four, three were visited in 2012 and chequered skipper not found, with the fourth being a square that was not visited in 2012. Most excitingly the butterfly was also found in an additional 32 new squares that were not part of the top 100.

The butterfly was found in 17 adjacent 1km squares in Glen Etive. Many of which are new squares for the butterfly. Other new squares have been found in Glen Nevis, near Lochaline, Acharacle, Kinlochleven and Taynuilt. Really exciting is the record at the western end of Ardnamurchan – which is about 12 miles from the next closest record. The 2012 map (Fig. 1) clearly shows the westward extension of the Chequered Skipper's range along the Ardnamurchan peninsula, although this may be due to previous under-recording.

Overall (2012 and 2013), the species has been detected in 68 new squares (Fig.1). In addition to showing changes in known distribution, a detailed analysis of the survey data has been undertaken. (Butterfly Conservation, 2014). This information will help determine what conservation measures should be taken to help the Chequered Skipper in the future.

In addition to surveying for new sites, Butterfly Conservation has been working with Forestry Commission Scotland to monitor known sites for both Chequered Skipper and Pearl-bordered Fritillary, *Boloria euphrosyne*. In 2012 a total of 14 transects were walked for Chequered Skipper and 9 timed counts undertaken (Prescott, 2013), and even more in 2013, giving much-improved coverage for this important species. Forestry Commission Scotland are very keen for this to continue for at least three more years, and timed counts can be compared directly to FCS data.

A great deal of valuable data has been collected so far. Apart from recording Chequered Skipper, other priority species were recorded including Pearl-

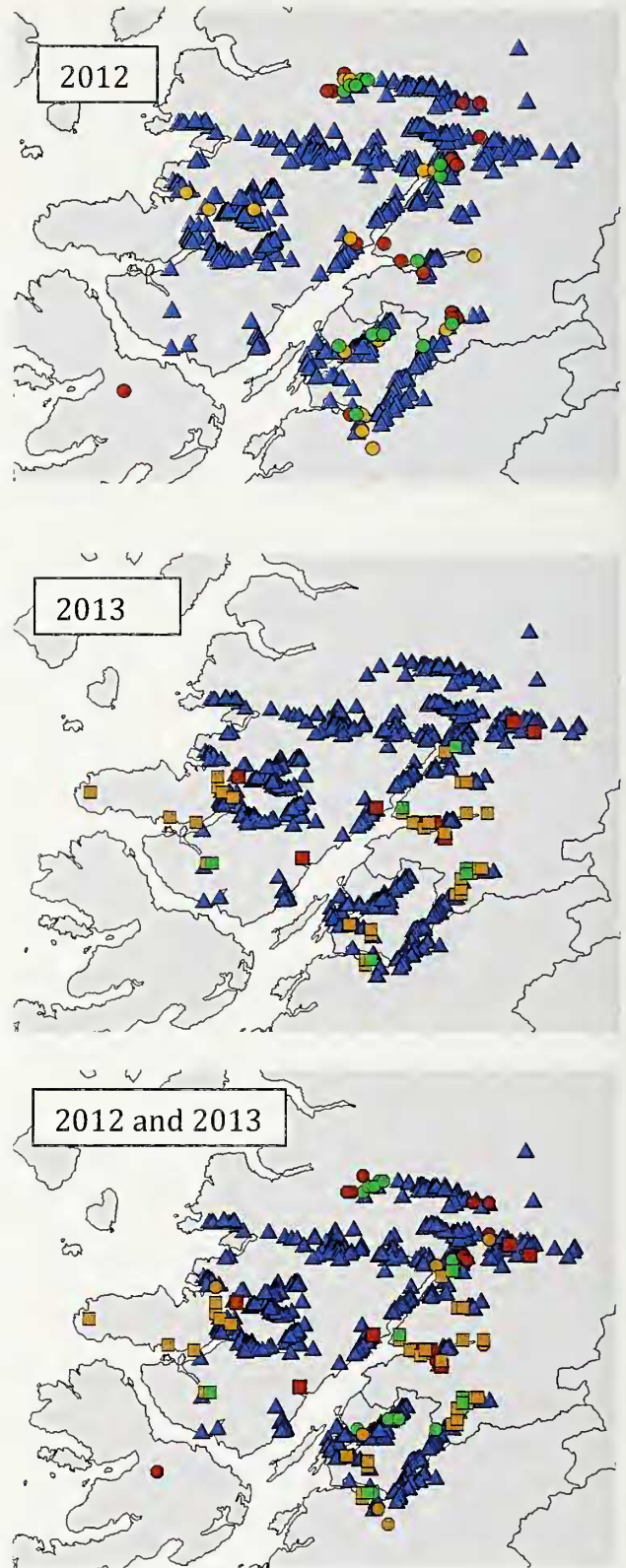


Fig. 1. Chequered skipper survey results for 2012, 2013 and 2012 and 2013 combined. Key: Blue Triangles = CS records 1980-2011. Green circles/squares = targeted 1km squares where CS was found. Red circles/squares = targeted 1km squares surveyed but CS was not found. Orange circles/squares = other new 1km squares where CS was recorded. NB: One Red Square in North-west Sutherland is not shown on the map.

bordered Fritillary, Narrow-bordered Bee Hawk-moth, *Hemaris tityus* and the Forester moth, *Adscita statice*. This methodology may well be suitable to try with other butterfly species. The most likely candidates are Pearl-bordered Fritillary and possibly Mountain Ringlet, *Erebia ephron*.

Such modelling techniques are a useful way of directing recorders to areas where target species are most likely to occur and shows that this is a good and efficient use of volunteers to undertake such work. The more work that is done on the ground, the more we can learn about this fascinating and scarce butterfly.

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